

# Clinical Algorithm for Acute Appendicitis in Reducing Negative Appendectomy Rate (NAR)

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**Abstract:** *Appendicitis is the most common cause of acute surgical abdomen with high negative appendectomy rate (NAR), being diagnosed clinically. RIPASA, ALVARADO scoring system along with imaging modalities have been used for accurate diagnosis. In this study an algorithm is established wherein the imaging modalities along with RIPASA scoring system have been used to arrive at the accurate diagnosis thereby reducing NAR. 250 cases of pain in RIF were considered in the study for acute appendicitis. RIPASA and USG in combination were able to diagnose 88% of the cases with only 2 negative appendectomy, showing high diagnostic accuracy. Cut off value for RIPASA was taken 7*

**Keywords:** Acute appendicitis, Scoring system, Negative appendectomy rate

## 1. Introduction

Appendicitis is the most common cause of an acute surgical abdomen with an incidence of 7-8% in one's whole life<sup>[1]</sup>. Any delay in diagnosing the condition may prove fatal as there are chances of perforation and related complications with high morbidity and mortality<sup>[2]</sup>. Moreover complication rate seems to be higher on either side of age group i.e in children and elderly population.

Acute appendicitis along with its protean manifestations usually mimics almost any acute abdominal illness thereby leading to difficulty in diagnosis. Currently USG, CT and various other modalities are being used to diagnose the condition. Despite all the technological advances, diagnosis of acute appendicitis is primarily based on proper and detailed history and clinical examination. Prompt diagnosis and intervention may reduce the risk of perforation and related complications.

Negative appendectomy rate (NAR) is defined as the rate of surgically removed appendices that are pathologically normal<sup>[3,4]</sup>. NAR varies from 2-11% and is more in women than men. The ALVARADO score, modified ALVARADO score and the RIPASA score are the scoring systems usually employed in diagnosis of acute appendicitis and help in reducing the negative appendectomy<sup>[4,5,6]</sup>.

Pain migrating from umbilicus to right iliac region is usually considered as the best indicator of acute appendicitis while the absence of pain prior to vomiting almost always rules it out. With the above mentioned diagnostic tools and proper

examination concurrently applied together within a single clinical algorithm, it will help reduce the Negative Appendectomy Rate without increasing the rate of complications.

## 2. Aims And Objectives

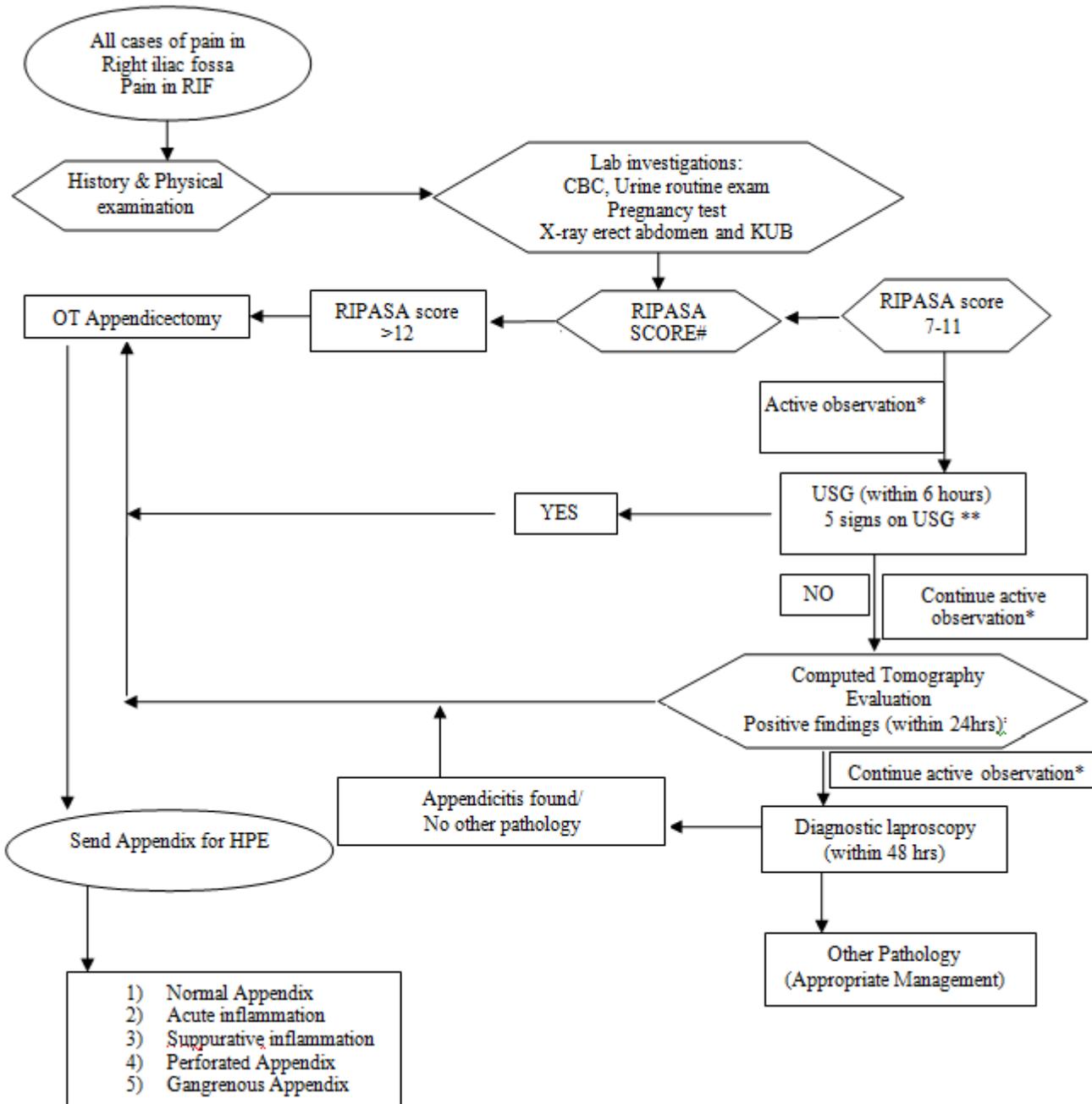
To evaluate a clinical algorithm in acute appendicitis with the aim to decrease the Negative appendectomy rate by using RIPASA score, USG, CT evaluation and diagnostic laparoscopy without increasing the rate of complications.

## 3. Materials and Methods

This is a prospective study of 250 patients conducted at a tertiary health care centre from September 2015 to March 2017. The study was approved by the Institute Review Board. Written and informed consent was obtained from all patients before their inclusion into the study. Patients presenting to surgical OPD with pain in right iliac fossa were evaluated. Those with a clinical diagnosis of acute appendicitis were included in the study. Exclusion criteria included those patients who were managed conservatively and were discharged without any surgical intervention.

Clinical algorithm was made with the aim to decrease the negative appendectomy rate by using RIPASA score, USG, CT evaluation and diagnostic laparoscopy.

**The algorithmic system:**



# Various scoring systems have been developed in the past. RIPASA scoring system is one of the most sensitive and specific system with a specificity and sensitivity above 90% for a score >12. Total score is achieved by adding all the scores for each category together.

**Ripasa Score:**

Sr. No.	Criteria	Score
1	Patients:	
	• Female	0.5
	• Male	1
	• <40years	1
	• >40years	0.5
2	Symptoms:	
	• RIF Pain	0.5
	• Pain migrating to RIF	0.5
	• Anorexia	1
	• Nausea/ Vomiting	1

	• Duration <48hrs	1
	• Duration >48hrs	0.5
3	Signs:	
	• RIF tenderness	1
	• Guarding	2
	• Rebound tenderness	1
	• Rovsing sign	2
	• Fever >37°C <39°C	1
4	Investigations:	
	• Raised WBC	1
	• Negative urine analysis	1

*Guidelines for management according to total RIPASA score:*  
 • < 5 = Probability of acute appendicitis is unlikely; observe patient in ward and repeat scoring after 1–2 hrs. If reducing

score, discharge. If increasing score, treat according to score level.

- 5–7.0 = Low probability of acute appendicitis; observe in ward and repeat scoring after 1–2 hrs. Patient may need ultrasound to rule out acute appendicitis. Patients may need admission for observations, discuss with surgeon on-call.
- 7.5–11.0 = Probability of acute appendicitis is high; refer patient to on-call surgeon for admission and repeat score in 1–2 hrs time. If remains high, prepare patient for appendectomy procedure. In female patients, perform abdominal ultrasound investigations to rule out gynaecological causes of RIF pain.
- > 12 = Definite acute appendicitis; refer to surgeon on-call for admission and appendectomy.

\* IV fluids and analgesics

- \*\* dilated appendix outer diameter > 6mm noncompressible  
distinct appendiceal wall layers due to oedema  
target appearance (axial section)  
**appendicolith** - an echogenic focus with posterior shadowing  
periappendiceal fluid collection  
echogenic and prominent periappendiceal and pericaecal fat  
surrounding hypervascularity on colour Doppler

\*\*\*Signs of appendicitis on CT scan include lack of oral contrast (oral dye) in the appendix, direct visualization of appendiceal enlargement (greater than 6 mm in cross-sectional diameter), and appendiceal wall enhancement with IV contrast (IV dye)

All removed appendices were sent for Histopathological examination and were reported as

- Normal appendix
- Acute appendicitis
- Suppurative appendicitis
- Perforated appendicitis
- Gangrenous appendicitis

Perforated and gangrenous appendixes were considered as complications of acute appendicitis.

All the patients were observed post-operatively (on iv antibiotics, iv analgesics and supportive fluids). If there were no complications, sutures were removed and patients discharged on 8<sup>th</sup> post-operative day.

All the data was collected and statistically analyzed using Chi-square test as applicable using SPSS (version 17) to calculate the overall sensitivities, specificities for the purpose of this study.

## 4. Results

Out of the 250 cases, in 43 cases where the RIPASA score was  $\geq 12$ , the score was used as the only diagnostic criteria for acute appendicitis and was followed by appendectomy. The RIPASA score was 100% accurate in these cases. In the remaining 207 patients where the RIPASA score was between 7 and 11, USG was performed within next 6 hours. Out of these, 167 showed signs of acute appendicitis and 11 showed complicated appendicitis, followed by

appendectomy and HPE. 2 cases were reported as normal appendix on HPE. The remaining 27 cases with a RIPASA score between 7 and 11 and a negative USG underwent CT scan. 19 cases showed positive sign of acute appendicitis on CT scan with negative appendectomy in 1 case. Rest of 8 cases, where RIPASA score was between 7 and 11 and with negative USG and negative CT scan but with complains of RIF pain and clinical features of acute appendicitis were subjected to diagnostic laparoscopy, followed by appendectomy.

## 5. Discussion

Most of the subjects under study were males as compared to females, 63% and 37% respectively. In the study by Hasan Erdem et al. (2013), out of the 113 patients with acute appendicitis, 62 were males and 51 females<sup>[7]</sup>.

The most common perioperative finding was acutely inflamed appendix (81%) followed by perforated appendix (8%), gangrenous appendix (9%) and appendicular lump (1.5%). However, histopathological diagnoses were acute appendicitis (48.8%), suppurative appendicitis (33.6%), perforated appendix (8.0%), gangrenous appendix (8.4%).. Normal histology was seen in 1.2% cases.

In our study 207 cases who had RIPASA score 7 – 11.5 were subjected to USG. The USG findings showed an increased diameter of more than 6 mm in 163 cases, a target sign in 113 cases, non-compressible appendixes in 96 cases, and wall layer edema in 32 cases. Appendicoliths were seen in 21 patients.

180 cases had positive findings on USG, underwent surgery, and out of these, 167 proved to have acute/suppurative appendicitis on HPE, 11 case of complicated appendicitis and 2 case found be normal. Similar finding were seen in a study conducted by Sachar Sudhir, (2013). The main USG features for diagnosing acute appendicitis were an incompressible appendix with a transverse outer diameter of >7 with incompressible periappendiceal inflamed fat with or without an appendicolith in there study<sup>[8]</sup>.

The diagnosis of acute appendicitis using RIPASA score with USG and CT scan, confirmed by HPE, was statistically significant. Among 250 cases with positive findings on RIPASA/USG/CT/DL, 247 cases were detected as acute or complicated appendicitis on histopathology.

Giuseppe D'Ippolito, Giselle Guedes Netto de Mello, Jacob Szejnfeld (1998) established the accuracy of unenhanced CT in the preoperative diagnosis of acute appendicitis. Acute appendicitis was confirmed in 19 cases using CT scan<sup>[9]</sup>.

In the present study, NAR came out to be 1.2%. Similar findings were observed in a study by Subedi N, Dangol US, Adhikary MB, Pudasaini S, Baral R (2011) who analyzed clinical presentation of acute appendicitis and its histopathological correlation<sup>[10]</sup>. Out of 345 patients who underwent operative procedure, 98% (n= 338) were proved to be acute appendicitis.

## 6. Conclusion

Clinical examination with RIPASA score  $\geq 12$  in 43 cases, when used alone, was able to diagnose acute appendicitis with 100% accuracy, confirmed by HPE. The rate of complicated appendix was as high as 65% in this group. In cases with RIPASA score 7-11.5, most were acute or suppurative appendicitis, 11 were complicated and a few were normal. Here USG with the classical 5 signs was used as adjunct for diagnosing acute appendicitis.

We were able to diagnose 88.4% of the cases with the use of RIPASA score and USG with only 2 negative appendectomy. These two modalities together had a high specificity and sensitivity and a high positive predictive value.

In 27 cases who underwent CT scan, 19 were diagnosed as acute appendicitis, out of which 1 case turned out to be normal. A cross sectional diameter  $>6$  mm, was a reliable indicator for acute appendicitis, if we go according to our algorithm.

Diagnostic laparoscopy was used in 8 cases; all of them were confirmed acute appendicitis on HPE. A NAR of 1.2% was achieved using clinical examination, RIPASA score and all these diagnostic tools with decrease in the acceptable rate of complications. The rate of complications was 16.4% only.

The cut-off value of RIPASA can be kept as 7 as we found in our study that those with score 7-11.5 had mostly acute/suppurative appendicitis. By evaluating using this clinical algorithm we were able to reduce the NAR without increasing the rate of complications.

### Tables

**Table 1:** Association between RIPASA score and HPE in case group

HPE	RIPASA			Total	Percentage
	$\geq 12$	11.5 - 7	11.5 - 7, -ve USG, +ve CT/+ve DL		
Acute appendicitis	9	104	9	122	48.8
Suppurative appendicitis	4	63	17	84	33.6
Perforated appendicitis	14	6	0	20	8
Gangrenous appendicitis	16	5	0	21	8.4
Normal appendix	0	2	1	3	1.2
Total	43	180	27	250	100

**Table 2:** Association between RIPASA with USG/CT/DL findings and HPE in cases group

	HPE		Total	Specificity
	Acute appendicitis	Normal Appendix		
RIPASA $>12$	43	0	43	100
RIPASA score $\geq 7$ with positive USG findings	178	2	180	98.8
RIPASA score $>7$ with negative USG findings but positive CT	18	1	19	94.7
RIPASA $>7$ , Neg USG, Neg CT, underwent DL	8	0	8	100
Total	247	3	250	

**Table 3:** Association of Cumulative RIPASA score with USG/CT/DL findings and HPE report

	HPE		Total	Sensitivity
	Acute appendicitis	Normal Appendix		
RIPASA $\geq 12$	43	0	43	17.2
RIPASA score $\geq 7$ and/or positive USG	221	2	223	88.4
RIPASA score $>7$ and/or positive USG/CT findings	239	3	242	95.6
RIPASA score $>7$ , and/or positive USG/CT/DL	247	3	250	98.8
Total	247	3	250	

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